Rocky Mountains Southwest Great Plains

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Service Life of Treated and Untreated Rocky Mountain Area Fenceposts: A Progress Report

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Preliminary service-life tests indicate that ponderosa pine, Engelmann spruce, lodgepole pine, and Douglas-fir fenceposts treated with preservative are performing favorably after field exposures of 15 to 22 years.

Keywords: Fenceposts, preservatives, forest products.

During 1960 and 1961, ponderosa pine posts were installed on two test sites in the northern Great Plains, one in the semiarid, western portion near Scenic, S.Dak., and the other in the more humid, eastern portion near Brookings. The site near Scenic has two plots; one is well drained, and the other poorly drained. The site near Brookings has one plot. A total of 975 ponderosa pine fence posts were set 2.5 feet deep, on three rectangular plots. Each plot contained 325 posts, with 13 posts in each of 25 rows. One post from each treatment and retention level and one untreated post were randomly located in each row. Posts were spaced 3 feet apart in each direction (fig. 1). Local treating plants using commercial methods treated the posts in the study. Initial results of the service tests were reported in a progress report by Markstrom and Clark (1975). Details on the treating procedures and chemical composition of the preservatives will be reported at the conclusion of the study.

During 1968, Engelmann spruce, lodgepole pine, and Douglas-fir were treated by the regular and modified double-diffusion methods. A total of 300 posts were installed in a test plot, at the Central Plains Experimental Range, at Nunn, Colo. The site was selected to test posts under semiarid service conditions of the Central Plains. The rectangular plot consisted of 25 rows of 12 posts set 2.5 feet deep and 3 feet apart in each direction. One post from each treatment and species combination and one untreated post from each species were randomly located in each row. Details of the treating procedure were reported by Markstrom et al. (1970).

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An annual inspection to test service life consisted of applying a 50-pound load to the top of each post. Any post that broke off when pulled or that had deteriorated in the top or that could no longer hold a staple was recorded as a failure.

Results

Test results of the ponderosa pine posts in South Dakota show that, after 21 to 22 years of service at both test sites, no posts failed under the following treatment and retention levels: PP-7.1, H&CC-9.6, and VP-4.7 (table 1). Only one and two failures occurred from the PC-8.1 and PC-8.6 treatments respectively. The PO-0.41 and PO-0.63 treatments each had 3 failures (4%).

The H&CC-7.1 treatment had 4 failures (5%), and CSP-5.6 had 8 failures (11%). The VP-3.0 treatment had 14 failures (19%), and CSP-3.9 had 15 failures (20%), all at Brookings. The OMS treatment had 49 failures (65%), 20 of which were at Brookings, 19 on the poorly drained plot, and 10 on the well drained plot near Scenic. The untreated posts totaled 74 failures (99%).

Test results of the Engelmann spruce, lodgepole pine, and Douglas-fir posts at the Nunn, Colo. plot show that none of the treated posts have failed during the 15 years of service. A total of 20 untreated posts, 9 Douglas-fir (36%), 8 Engelmann spruce (32%), and 3 lodgepole pine (12%) have failed (table 2).

All of the failures were caused by butt decay at or near the groundline. No posts have checked or deteriorated to the extent that fence staples would not have held.

Figure 1.—Posts are being tested with the 50-pound lateral pull.

Table 1.—Service record of 975 Black Hills ponderosa pine posts, untreated and treated with preservatives, installed on two test sites (three plots) in the Northern Great Plains of South Dakota in 1960 and 1961, with failures recorded by 1982.

Treatments[1]	Retention		Sapwood penetration	Failures recorded by 1982			
	Target	Average		Semiarid, western (Scenic) Well drained	Semiarid, western (Scenic) Poorly drained	Humid eastern (Brookings)	All sites
	Lb/ft³		Percent				
PRESSURE TREATMENTS:							
PC ----- 50% petroleum distillate	3	8.10	82.0	0	0	5	1
and 50% coal tar creosote	6	8.60	100.0	8	0	0	3
PP ----- 5% pentachlorophenol in petroleum oil[2]	6	7.10	100.0	0	0	0	0
P0 ----- Osmosalts[3]	0.35	0.41	62.0	0	8	4	4
	.55	.63	64.0	0	0	13	4
NONPRESSURE TREATMENTS:							
H&CC -- Hot and cold bath in	3	7.10	51.0	8	4	4	5
100% coal tar creosote	6	9.60	81.0	0	0	0	0
CSP ---- Cold soak, 5% pentachloro-	3	3.90	80.0	0	0	63	20
phenol in petroleum oil[2]	6	5.60	93.0	4	0	30	11
OMS --- Osmoplastic, butt dip only	—	—	18.7	40	76	80	65
VP ----- Vacuum, 5% pentachlorophenol	3	3.00	72.0	0	0	58	19
in petroleum oil[2]	6	4.70	89.0	0	0	0	0
UNTREATED (CONTROL)	—	—	—	96	100	100	99

[1]*The term pressure indicates that pressure beyond that of the atmosphere was applied to the preservative during treatment; vacuum indicates that a partial vacuum was drawn and held on the posts before the preservative was applied at atmospheric pressure.*

[2]*Retention values include the weight of the solvent.*

[3]*Osmosalts, as described by the manufacturer, contains: sodium fluoride, 33.0%; disodium arsenate, 25.0%; sodium bichromate, 32.3%; dinitrophenol, 6.3%. Osmoplastic compound contains: sodium fluoride, 43.7%; dinitrophenol, 3.1%; potassium bichromate, 2.0%. Solvent in Osmoplastic compound was Avenarius Carbolineum supplied by the Carbolineum Wood Preserving Company.*

Trade and company names are used for the benefit of the reader, and do not imply endorsement or preferential treatment by the U.S. Department of Agriculture.

Conclusions

Treated fenceposts have a longer service life than untreated posts. Performance of the osmoplastic butt-dip treatment is below that of other treatments, perhaps because of limited preservative penetration of the sapwood at all plots. Performance of the CSP-3.9 and VP-3.0 treatments are also below that of the other treatments at the Brookings plot (table 1).

The probable life of a post is an estimate of the average life through the use of mortality curves; the estimate can be made after 10% or more of the posts have failed (MacLean 1951, Blew and Kulp 1964). For untreated ponderosa pine posts, the probable life at the Brookings plot and the poorly drained plot near Scenic is 12 years, and at the well drained plot 16 years. The average life of the 25 untreated posts at Brookings and the Scenic poorly drained plots was 11 years. The probable life at Brookings of the OMS posts was 19 years, the VP-3.0 posts 21 years, the CSP-3.9 posts 22 years, the CSP-5.6 posts 27 years, and the PO-0.63 posts 33 years. The probable life of the OMS posts at the Scenic poorly drained plot was 20 years, and at the well drained plot was 25 years.

The probable life of the untreated posts at the Nunn, Colo. plot was 17 years for Douglas-fir, 18 years for Engelmann spruce, and 23 years for lodgepole pine.

For the remaining treatments, estimating and comparing probable service life would be premature because of the low percentages of failures.

The equivalent uniform annual costs per post for each of the treatments to date are shown in tables 3 and 4. These cost estimates are for analysis periods of 22 years for the South Dakota posts and 15 years for the Colorado posts. This financial analysis indicates that the annual service costs for the treated and untreated posts are different, depending on the treatment, and given the assumptions as footnoted in tables 3 and 4. The annual service cost of the osmoplastic butt-dip treatment is the highest. The analysis indicates that the service cost of untreated posts compares favorably with that of treated posts at some of the plots. However the inconvenience of replacing untreated posts more frequently than treated posts would probably favor the use of treated posts.

Table 2.—Service record of 300 lodgepole pine, Engelmann spruce, and Douglas-fir posts, untreated and treated by the double-diffusion process, installed on a test site in the Central Plains near Nunn, Colorado in 1968, with failures recorded by 1983.

Treatments[1]	Retention of Chemicals[2]				Failures by 1983
	$CuSO_4$	Na_2CrO_4	Na_2HAsO_4	Total Salts	
	Lb/ft³				%
Engelmann spruce					
1 day Cu, 1 day As-Cr	.20 (.10)	.14 (.09)	.18 (.13)	.52 (.32)	0
3 days Cu, 3 days AS-Cr	.29 (.14)	.19 (.12)	.21 (.15)	.69 (.41)[3]	0
8 hrs. hot Cu, 1 day As-Cr	.26 (.13)	.31 (.19)	.27 (.19)	.84 (.51)	0
UNTREATED (CONTROL)	—	—	—	—	32
Lodgepole pine					
1 day Cu, 1 day As-Cr	.24 (.12)	.12 (.07)	.14 (.10)	.50 (.29)	0
3 days Cu, 3 days As-Cr	.33 (.16)	.39 (.24)	.35 (.25)	1.07 (.65)[3]	
8 hrs. hot Cu, 1 day As-Cr	.38 (.19)	.24 (.15)	.23 (.16)	.85 (.50)[3]	0
UNTREATED (CONTROL)	—	—	—	—	12
Rocky Mountain Douglas-fir					
1 day Cu, 1 day As-Cr	.15 (.07)	.08 (.05)	.08 (.06)	.31 (.18)	0
3 days Cu, 3 days As-Cr	.26 (.13)	.16 (.10)	.16 (.11)	.58 (.34)	0
8 hr. hot Cu, 1 day As-Cr	.22 (.11)	.18 (.11)	.15 (.11)	.55 (.33)	0
UNTREATED (CONTROL)	—	—	—	—	36

[1]*The following treating chemicals and schedules were followed:*

A. 1 day in $CuSo_4$ + 1 day in $Na_2HAsO_4 - Na_2CrO_4$.
B. 3 days in $CuSO_4$ + 3 days in $Na_2HAsO_4 - Na_2CrO_4$.
C. 8 hours in hot $CuSO_4$ (200° F.) + 1 day in cold $Na_2HAsO_4 - Na_2CrO_4$.

The concentration of the $CuSo_4$ in water was 10% and the $Na_2HAsO_4 - Na_2CrO_4$ in water was 13%.

[2]*Numbers in parentheses represent retentions based on oxides (CuO, CrO_3, As_2O_5).*

[3]*Treatment met total salts retention requirement of 0.40 lb/ft³ of chromated copper arsenate (based on the oxides CrO_3, CuO, and As_2O_5) as given in AWPA C-5 Posts.*

Literature Cited

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Table 3.—Annual service cost of treated and untreated ponderosa pine posts at the semiarid western and humid eastern South Dakota plots.

Treatments	Retention of preservatives	Equivalent uniform annual cost per post[1] Semiarid Western Well drained	Poorly drained	Humid eastern
	Lb/ft³	---------- Dollars ----------		
PRESSURE TREATMENTS:				
PC ------50% petroleum distillate	8.10	.68	.68	.69
and 50% coal tar creosote	8.60	.71	.68	.68
PP ------5% pentachlorophenol in petroleum oil	7.10	.68	.68	.68
PO ------Osmosalts	0.41	.68	.69	.69
	.63	.68	.68	.72
NONPRESSURE TREATMENTS:				
H&CC ---Hot and cold bath in	7.10	.72	.69	.70
100% coal tar creosote	9.60	.68	.68	.68
CSP -----Cold soak, 5% pentachlorophenol	3.90	.68	.68	.77
in petroleum oil	5.60	.69	.68	.72
OMS ----Osmoplastic, butt dip only	—	.73	.82	.86
VP ------Vacuum, 5% pentachlorophenol	3.00	.68	.68	.76
in petroleum oil	4.70	.68	.68	.68
UNTREATED (CONTROL)	—	.68	.74	.74

[1] *The equivalent uniform cost is based on the following:*

A. A capital recovery factor with 10% compound interest,
B. An analysis period with no salvage value of 22 years, and
C. An installed cost of $4.35 for untreated posts and $6.00 for the treated posts. A new post replacing a failed post was assumed to have the same service life and installed cost as the failed post.

Table 4.—Annual service cost of treated and untreated Engelmann spruce, lodgepole pine, and Douglas-fir posts at the semiarid Central Plain plot near Nunn, Colorado.

Treatments	Retention of total salts	Equivalent uniform annual cost per post
	Lb/ft³	Dollars
Engelmann spruce		
1 day Cu, 1 day As-Cr	.52 (.32)[2]	.79
3 days Cu, 3 days As-Cr	.69 (.41)	.79
8 hrs. hot Cu, 1 day As-Cr	.84 (.51)	.79
UNTREATED (CONTROL)	— —	.72
Lodgepole pine		
1 day Cu, 1 day As-Cr	.50 (.29)	.79
3 days Cu, 3 days As-Cr	1.07 (.65)	.79
8 hrs. hot Cu, 1 day As-Cr	.85 (.50)	.79
UNTREATED (CONTROL)	— —	.65
Rocky Mountain Douglas-fir		
1 day Cu, 1 day As-Cr	.31 (.18)	.79
3 days Cu, 3 days As-Cr	.58 (.34)	.79
8 hrs. hot Cu, 1 day As-Cr	.55 (.33)	.79
UNTREATED (CONTROL)	— —	.71

[1]*The equivalent uniform annual cost is based on the following:*

A. A capital recovery factor with 10% compound interest,
B. An analysis period with no salvage value of 15 years, and
C. An installed cost of $4.35 for untreated posts and $6.00 for the treated posts. A new post replacing a failed post was assumed to have the same service life and installed cost as the failed post.

[2]*The numbers in parentheses retentions based on oxides (CuO, CrO_3, As_2O_5).*

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